NYC's Urban Heat Island—Characterizing Sources of Heat from Typical Urban Surfaces

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Abstract

This project studies temperatures of typical urban surfaces to understand urban heat island mitigation. Contrasting environmental conditions include white versus black roofs, natural versus artificial turf, shaded versus non-shaded areas, and bare versus ivied walls. East Harlem is also studied. Infrared thermosensors measure surface and air temperatures there. Analysis shows that high albedos and evapo-transpiration can cause cooling. Urban heat island mitigation strategies that use these factors, such as vegetated and reflective surfaces, may be more effective. Preliminary evidence suggests that urban vegetation is significantly more effective than high-albedo surfaces.

Thermoworks IR Pro Thermosensor

Materials and Methods

Temperature readings were taken with Thermoworks Pro sensors mounted on tripods with umbrella-shaded air probes. Two simultaneous readings were taken in contrasting areas. These included grass, artificial turf, white roofs, and black roofs in the Bronx, and sidewalks in East Harlem. Later subjects were tree-shaded versus non-shaded areas by Morningside Park, and bare versus ivy-covered walls by Riverside Park.

Sponsors:
National Aeronautics and Space Administration (NASA)
NASA Goddard Space Flight Center (GSFC)
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NASA New York City Research Initiative (NYCRI)

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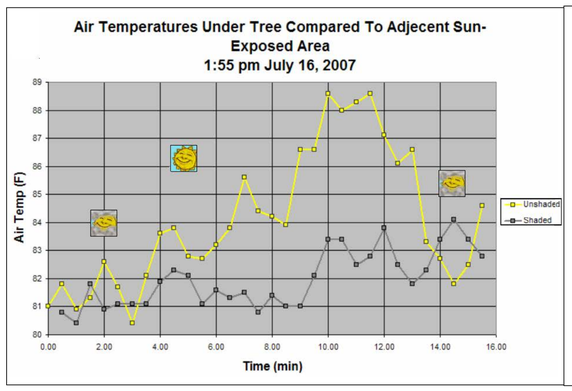
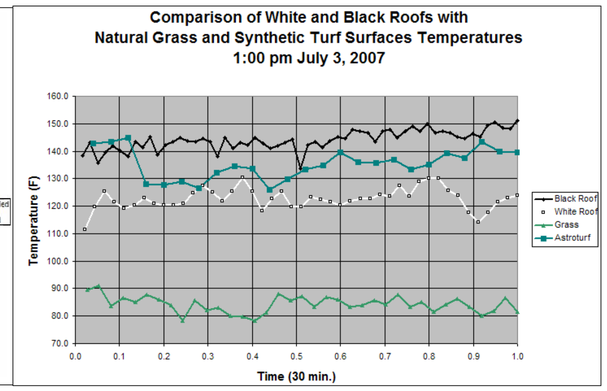
Bronx-Turf Field

Adjacent Grass Field





Experiment	Date	Where	Numbers	Results
White vs. Black	7/2/2007	Surface	White 95F, Black 125F	**White roofs are cooler**
		Air	White 71F, Black 71F	**Air over black roofs is cooler**
Grass vs. Turf	7/5/2007	Surface	Grass 74F, Turf 78F	**Grass is cooler**
		Air	Grass 78F, Turf 76F	**Air over turf is cooler**
Grass vs. Turf	7/6/2007	Surface	Grass 80F, Turf 121F	**Grass is cooler**
		Air	Grass 83F, Turf 85F	**Air over grass is cooler**
Grass vs. Turf	7/26/2007	Surface	Grass 88F, Turf 123F	**Grass is cooler**
		Air	Grass 85F, Turf 85F	**Air over grass is cooler**
All Four	7/3/2007	Surface	W 123F, B 144F, G 84F, T 135F	**Grass is the coolest**
		Air	W 82F, B 80F, G 75F, T 75F	**Air over grass is the coolest**
Shade vs. Open	7/16/2007	Surface	Shade 82F, Open 103F	**It is cooler in the shade**
		Air	Shade 82F, Open 84F	**Shaded air is cooler**
Shade vs. Open	7/17/2007	Surface	Shade 92F, Open 112F	**It is cooler in the shade**
		Air	Shade 86F, Open 87F	**Shaded air is cooler**
Ivy vs. Bare	7/17/2007	Surface	Ivy 81F, Bare 82F	**Ivied walls are cooler**
		Air	Ivy 88F, Bare 90F	**Air over ivied walls is cooler**
Ivy vs. Bare	7/24/2007	Surface	Ivy 81F, Bare 84F	**Ivied walls are cooler**
		Air	Ivy 84F, Bare 84F	**Air over bare walls is cooler**

I-Black and White Roofs II-Grass Field III-Astroturf Field

Overhead view of Bronx field. Four different surfaces in close proximity allowed simultaneous measurements.

Discussion & Conclusion

The Bronx data suggests two cooling factors: high albedo and evapo-transpiration. The white roof, having a higher albedo than the black roof, is cooler; the real grass field, having the ability to transpire, is cooler than the artificial turf field. Transpiration also seems to be stronger than an increase in albedo; the grass field was the coolest surface of the four. This suggests that while reflective surfaces are cooled, vegetation is even cooler. The Morningside Drive data confirms the intuition that it is cooler in the shade. Being under the tree cooled both air and sidewalk, and in sunlight shade temperatures more slowly than non-shaded temperatures. This is due more likely to shading than to evapo-transpiration.